Chapter 2 RCRA Closure and Corrective Action Program

2.0 Introduction

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This chapter presents guidance from the Indiana Department of Environmental Management (IDEM) Office of Land Quality (OLQ) for preparing Resource Conservation and Recovery Act (RCRA) closure plans, cleanup plans, and corrective action work plans to meet the requirements of 329 Indiana Administrative Code (IAC) 3.1.

Although the RISC Technical Resource Guidance Document offers a flexible generic framework for remedial activities in Indiana, certain hazardous waste rules preclude the sole use of the RISC Technical Guide as a directive in achieving RCRA closure and corrective action requirements. This chapter is intended to provide default options for achieving RCRA closure, or "No Further Action" (NFA) status for corrective action solid waste management units and areas of concern. RCRA Corrective Action requirements (Hazardous and Solid Waste Amendments [HSWA] of 1984) pertain to any facility that, at any time, had interim status as well as facilities that operated without a permit when they should have had one. An owner or operator of a facility regulated under HSWA is responsible for instituting corrective action as necessary to protect human health or the environment from releases of hazardous wastes or hazardous constituents.

This chapter is not intended to be all-inclusive in the discussion of requirements and responsibilities, or to limit the use of site-specific options that may differ from the default. The RISC Technical Resource Guidance Document establishes a framework for developing a non-default approach for RCRA closure or corrective action cleanup. Environmental requirements implemented by other programs (such as the Superfund Program and the Voluntary Remediation Program [VRP]) may still apply to a site or facility both before and after certification of RCRA closure.

Indiana is authorized to administer its hazardous waste management program in place of the federal program. To develop the hazardous waste program, the State has (with few exceptions and deletions) incorporated by reference the federal hazardous waste regulations in Title 40 of the *Code of Federal Regulations* (CFR), Parts 260 through 270. These federal regulations are mandated by Subtitle C of RCRA. For convenience, federal regulations (when appropriate) are cited in this chapter. In addition, the acronym "RCRA" is used throughout this chapter as a general term for hazardous waste regulatory requirements.

Questions that arise and requests for other guidance should be directed to the site-specific OLQ or Office of Enforcement (OE) contact. The procedures outlined in this chapter are intended to clarify and standardize the RCRA closure and corrective action process. Owners or operators are encouraged to meet with IDEM staff as needed to develop plans for remediation, ground water monitoring, and decontamination.

IDEM recognizes that the costs of closure and remediation may be significant and intends to minimize these costs wherever possible. Therefore, obtaining OLQ approval of a closure or cleanup plan is strongly recommended before any closure or cleanup activity is implemented. Closure or cleanup activities conducted prior to OLQ approval may need to be altered or even repeated if the closure or cleanup activities do not conform with applicable regulations or fail to protect human health and the environment.

This guidance is intended to replace the Non-rule Policy Document entitled Hazardous Waste Management Unit Closure Guidance, (identification number WASTE-0013-NPD).

2.1 Definitions

Many terms used in this non-rule policy document are defined in 329 IAC 3.1 and 40 CFR 260.10. The following additional definitions apply to facilities subject to regulation for RCRA hazardous waste permitting, corrective action, and closure only. These terms replace or supplement those in the Glossary of the RISC Technical Manual.

Active portion means the portion of a facility where TSD operations are being or have been conducted after the effective date of 40 CFR Part 261 and that is not a *closed portion* (see also *closed portion* and *inactive portion*).

Aquifer means a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of ground water to wells or springs.

Area of concern (AOC) means a unit or area that does not meet the definition of a *solid waste management unit (SWMU)* but that merits further investigation to determine the presence or absence of releases.

Certification means a statement of professional opinion based upon knowledge and belief.

Closed portion means the portion of a facility that an owner or operator has closed in accordance with the approved facility closure plan and all applicable closure requirements (see also *active portion* and *inactive portion*).

Closure of a hazardous waste (RCRA) facility means action taken to secure the hazardous waste management facility or unit(s) in a manner that will protect human health and the environment in accordance with the closure plan requirements of 40 CFR 265, Subpart G, and 40 CFR 264, Subpart G. Closure of a SWMU or AOC means that the owner or operator has demonstrated, either through investigation or remediation, that the unit or area does not warrant further action at this time.

Closure by removal or decontamination means the decontamination, treatment, or removal of the following: all hazardous waste, hazardous waste constituents, hazardous constituents, leachate, contaminated run-on and runoff, waste decomposition products, liners, and contaminated soil (including ground water) that pose a substantial present or potential threat to human health or the environment. This standard is achieved by demonstrating attainment with one of the following closure levels:

- estimated quantitation levels (EQL) for organic constituents, or the mean plus one standard deviation of background for non-organics. This type of closure is a "clean closure".
- default or non-default residential levels. This type of closure is a "residential closure".
- default or non-default industrial levels if the owner files a restrictive covenant which limits the land use of the property and certain activities that can occur at the property (i.e. prohibition on drinking untreated groundwater) in accordance with the approved risk assessment. This type of closure is an "industrial closure".

Closure in-place means leaving either waste in place (e.g. a landfill) or contamination in place after closure when contamination cannot be practicably removed during closure, and post-closure care of engineered structures or other facilities is needed. Closure in-place must comply with the applicable requirements for removing or stabilizing the waste, capping the hazardous waste management unit or utilizing other appropriate engineering controls, developing and

implementing a ground water monitoring plan, and providing a written post-closure care plan subject to IDEM approval.

Compliance point is a vertical surface located at the hydraulically down-gradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated unit(s). The waste management area can encompass more than one regulated unit (see 40 CFR 264.95).

Directed sampling is the term for using professional judgment and prior site knowledge to choose sampling locations. It is synonymous with the term "judgmental sampling".

Disposal means the discharge, deposit, injection, dumping, spilling, leak, or placement of any solid or hazardous waste into or on any land or water so that such solid or hazardous waste or any constituent thereof can enter the environment, be emitted into the air, or be discharged into any water, including ground water.

Disposal facility means a facility or part of a facility at which hazardous waste is intentionally placed into or on any land or water and at which waste will remain after closure. The term *disposal facility* does not include a corrective action management unit into which remediation wastes are placed.

Facility is defined as follows:

1. All contiguous land, structures, other appurtenances, and improvements on the land used for TSD of hazardous waste. A facility can consist of several TSD operational units (for example, one or more landfills, surface impoundments, or combinations of such units).

2. For the purposes of implementing corrective action under 40 CFR 264.101, all contiguous property under the control of the owner or operator seeking a hazardous waste management permit. This definition also applies to facilities implementing corrective action under Indiana Code (IC) 13-22-13.

Final closure or *total closure* means the closure of all hazardous waste management units at the facility in accordance with all applicable closure requirements so that hazardous waste management activities

under 40 CFR, Parts 264 and 265, are no longer conducted at the facility unless subject to the provisions in 40 CFR 262.34.

Generator means any person, by site, whose actions or processes produce hazardous waste identified or listed in 40 CFR, Part 261, or whose actions first cause a hazardous waste to become subject to regulation.

Ground water means water located below the ground surface in interconnected voids and pore spaces in the zone of saturation.

Ground water protection standard means a concentration limit (as defined in 40 CFR 264.94) established by the Commissioner in a facility permit for hazardous constituents (as defined in 40 CFR 264.93) detected in ground water from the regulated unit in the uppermost aquifer at the *compliance point* (as defined in 40 CFR 264.95) during the compliance period (as defined in 40 CFR 264.96). To establish this concentration limit, the Commissioner must consider which hazardous constituents are from the regulated unit and their potential to harm human health and the environment.

Hazardous constituent means any constituent identified in Appendix VIII of 40 CFR, Part 261**.**

Hazardous waste is defined in 40 CFR 261.3. For Corrective Action purposes, this term includes any chemical that poses or may pose a threat to human health or the environment (see IC 13-11-2-99).

Hazardous waste management unit is a contiguous area of land on or in which hazardous waste is placed, or the largest area in which there is significant likelihood of hazardous waste constituents mixing in the same area. Examples of hazardous waste management units include a surface impoundment, waste pile, land treatment area, landfill cell, incinerator, tank and its associated piping and underlying containment system, and container storage area. A container alone does not constitute a unit. The unit includes the containers and the land or pad upon which the containers are placed.

Industrial closure includes the decontamination, treatment, or removal from a unit of all hazardous waste, hazardous waste constituents, hazardous constituents, leachate, contaminated run-on and run-off, waste decomposition products, liners, and contaminated soil (including ground water) that pose a substantial present or potential threat to

human health or the environment at closure levels exceeding default or non-default residential levels but below industrial levels. Industrial closures are limited to commercial/industrial properties that have appropriate Standard Industrial Classification (SIC) codes listed in Appendix 4 of the RISC Technical Guide.

In operation refers to a facility that is treating, storing, or disposing of *hazardous waste*.

Inactive portion means the portion of a facility that is not operated after the effective date of 40 CFR Part 261 (see also *active portion* and *closed portion*).

Inner liner means a continuous layer of material placed inside a tank or container that protects the construction materials of the tank or container from the contained waste or reagents used to treat the waste.

Leachate means any liquid, including any suspended components in the liquid, that has percolated through or drained from hazardous waste.

Liner means a continuous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell that restricts the downward or lateral escape of *hazardous waste*, *hazardous waste constituents*, or *leachate*.

Management or *hazardous waste management* means the systematic control of the collection, source separation, storage, transportation, processing, treatment, recovery, and disposal of hazardous waste.

No further action at this time is a Corrective Action term meaning that the owner or operator of a TSD facility does not currently need to address a SWMU or AOC either because a release was not documented or because the owner or operator has taken appropriate action to ensure that human health and the environment are adequately protected.

On-site means the same or geographically contiguous property which may be divided by public or private right-of-way, provided the entrance and exit between the properties is at a crossroads intersection, and access is by crossing as opposed to going along the right-of-way. Non-contiguous properties owned by the same person but connected

by a right-of-way, which he controls and to which the public does not have access, is also considered on-site property.

Operator means the person responsible for the overall operation of a facility.

Owner means the person who owns a facility or part of a facility.

Partial closure means the closure of a hazardous waste management unit in accordance with applicable closure requirements in 40 CFR, Parts 264 and 265, at a facility that contains other active hazardous waste management units. For example, partial closure may include the closure of a tank (including its associated piping and underlying containment systems), landfill cell, surface impoundment, waste pile, or other hazardous waste management unit while other units of the same facility continue to operate.

Personnel or *facility personnel* means all persons who work at or oversee the operations of a hazardous waste facility and whose actions or failure to act may result in noncompliance with the requirements of 40 CFR, Part 264 or 265.

Point of compliance is a term used in RCRA but not in this User's Guide. To avoid confusion with similar terms, this chapter uses the term *compliance point*. The terms *point of compliance* and *compliance point* can be used interchangeably in RCRA.

Release means any spill, leak, pouring, emission, emptying, discharge, injection, pumping, escape, leaching, dumping, or disposal of hazardous wastes (including hazardous constituents) into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing hazardous wastes or hazardous constituents).

Remediation waste means all solid and hazardous wastes, all media (including ground water, surface water, soil, and sediment), and debris that contain listed hazardous wastes or hazardous constituents, or that themselves exhibit a hazardous waste characteristic and which is managed for the purpose of implementing Corrective Action requirements under 40 CFR 264.101 and RCRA Sections 3004(u), 3004(v), and 3008(h).

Representative sample means a sample of a universe or whole (for example, a waste pile, lagoon, or ground water) that can be expected to exhibit the average properties of the universe or whole.

Screening is a RISC term that refers to the initial sampling event of site characterization to determine the need for a broader investigation of the nature and extent of contamination.

Soil means unconsolidated earth material composing the superficial geologic strata (material overlying bedrock) consisting of clay, silt, sand, or gravel particles as classified by the U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS) or a mixture of such materials with liquids, sludges, or solids that is inseparable by simple mechanical removal processes and that is primarily composed of soil by volume based on visual inspection.

Solid waste is defined in 40 CFR 261.2.

Solid waste management unit (SWMU) means any discernable existing or historical unit (permitted or unpermitted) at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility where hazardous constituents have been routinely and systematically released.

Storage means the holding of hazardous waste for a temporary period at the end of which the hazardous waste is treated, stored, or disposed of elsewhere.

Treatment means any method, technique, or process, including neutralization, that achieves the following:

- Changes the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, recover energy or material resources from the waste, or render such waste non-hazardous or less hazardous
- Makes the waste safer to transport, store, or dispose of
- Makes the waste amenable for recovery or storage or reduces the volume of the waste

Unit means either a *hazardous waste management unit* or a *SWMU* unless otherwise specified.

Unsaturated zone or *zone of aeration* means the zone between the land surface and the water table.

Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.

2.2 Closure Overview

Closure levels, regulations, and agency review and public notice of closure plans are discussed below.

2.2.1 Closure Levels

Closure in this chapter is used to describe the process of taking a RCRA hazardous waste management unit (i.e. a treatment, storage, or disposal [TSD] unit) out of service. Closure is required for all hazardous waste management units following termination of interim status, after denial of an operating permit, or after facility closure.

With the development of the RISC Technical Guide, default closure levels have been established using conservative exposure assumptions. These levels have been determined to be protective of human health and the environment and are presented in Table A of Appendix 1 of the RISC Technical Guide. The table provides constituent closure levels based on residential exposure assumptions and on industrial exposure assumptions.

There are two general types of closure:

1) closure by removal or decontamination, and

2) closure with waste or contamination remaining in place.

The premise of closure by removal or decontamination (hereafter referred to as "closure by removal") is that all hazardous waste has been removed from a RCRA TSD unit and any releases at or from the unit have been remediated so that further regulatory control under RCRA Subtitle C is no longer necessary to protect human health and

the environment. Closure by removal is accomplished either by demonstrating that:

(1) constituent levels in soil do not exceed the analytical method's EQL for organics and the mean plus one standard deviation of background levels for inorganics, or
(2) constituent levels remaining in soil do not exceed default or non-default residential closure levels, or
(3) constituent levels remaining in soil do not exceed default or non-default industrial levels if a restrictive covenant has been placed on the property which limits the use of the property to land uses and/or activities consistent with the approved risk assessment.

Closure levels for ground water may be: the constituent concentrations listed in 40 CFR 264.94(a); the Maximum Contaminant Limit (MCL) in 40 CFR 141; the alternate concentration limits (ACL) established in accordance with 40 CFR 264.94(a)(3); or background levels for each constituent as specified in the permit, if applicable.

A facility that meets industrial closure levels would not be subject to post-closure requirements. ***However, a restrictive covenant that limits the activities and/or land use consistent with the approved risk assessment must be established.*** Industrial cleanup levels must be achieved throughout the closed unit and in any areas affected by releases from the unit. This scenario cannot be used at units where waste remains in place (such as land disposal units that closed in-place). Further information relating to industrial closure is presented in Section 2.6.2 of this User's Guide.

Closure in-place involves leaving waste in place or leaving contamination exceeding industrial closure levels in place. This category includes all land disposal units and other units where contaminants in excess of industrial closure levels remain in place and engineering controls are needed to achieve the closure performance standard. Land disposal units require capping and maintenance (along with ground water monitoring) for the post-closure period. At other units where waste has been removed, but contamination remains, there is a need for some continuing engineering controls or other structures to insure that the exposure and land use assumptions remain valid. These units may be eligible for more limited post-closure care than land disposal units, depending on the circumstances. More information is provided in Section 2.6.3.1 of this Guide.

2.2.2 Closure Regulations

IDEM regulates the management of hazardous waste under the authority of the Environmental Management Act, IC 13, and the Indiana hazardous waste rules, 329 IAC 3.1 *et seq*. These rules incorporate, by reference, 40 CFR Parts 260 through 270. Closure of hazardous waste facilities under interim status is regulated under 40 CFR 265, Subpart G, and 329 IAC 3.1-10 and 14. Closure of facilities that have Part B permits is regulated under 40 CFR 264, Subpart G; 40 CFR 270.1(c)(5); and 329 IAC 3.1-9 and 15. Copies of 329 IAC 3.1 *et seq*. can be obtained by calling the Legislative Services Agency at (317) 232-9581. Copies of 40 CFR Parts 260 through 299 can be obtained by writing to the following address:

U.S. Government Printing Office
Superintendent of Documents
Mail Stop: SSOP
Washington, DC 20402-9328

2.3 Corrective Action Overview

Corrective Action's goal is to evaluate the potential for release of hazardous constituents and remediate releases as necessary to protect human health and the environment. Corrective Action requirements pertain to any facility that is operating or had operated as a TSD facility. This includes facilities that had interim status at any time, as well as facilities that operated without a permit when they should have had one. Corrective Action can be initiated through either a permit, if applicable, or an order. Facilities can attempt to close hazardous waste management units at the same time they are addressing releases from SWMUs and AOCs. Under this situation, the facility can request to complete closure of the hazardous waste management unit through the RCRA corrective action process.

The RCRA Corrective Action process consists of five key elements:

- Potential source identification
- Release assessment
- Release investigation
- Evaluation and selection of an appropriate remediation technology or technologies

- Remediation of the release(s)

Not all five elements need to be performed at all facilities. However, each facility subject to corrective action will be evaluated for its potential to release hazardous constituents. If the potential exists, the facility must perform a release assessment. The decision to proceed to subsequent elements depends on the level and type of hazardous constituent present. In order to achieve a "no further action at this time" determination for the facility, it must be demonstrated that either hazardous constituent levels do not exceed background levels or EQLs or that hazardous constituents do not pose unacceptable risks to human health or the environment. This determination can be performed either after the release assessment or the release investigation, or upon completion of remediation activities.

2.4 Closure Plan Preparation

In accordance with 40 CFR 264.112 and 265.112, the closure plan must identify steps necessary to perform partial or final closure of the facility at any point during its active life. To this end, the following sections detail the type of information that must be included in the closure plan.

2.4.1 Facility Description

A facility description must be provided that includes the following information:

1. Description of the type of industry
2. Standard Industrial Code (SIC)
3. Products
4. Location
5. Size
6. Other permitted activities occurring on site (for example, discharge using a National Pollutant Discharge Elimination System [NPDES] permit)
7. Other general summarized information

2.4.2 Description of Waste Management Units

The closure plan should describe each container storage area, tank system, incinerator, land treatment unit, landfill, surface impoundment,

waste pile, or other hazardous waste management unit that is to be addressed. For each unit, the following information must be provided:

1. A discussion of the types of waste management activities that occurred at the unit, including the capacity and the maximum inventory of the unit and the process code and unit of measure from the Part A permit application (if applicable)

2. Descriptions of each waste in the unit, including the common name(s) and U.S. EPA hazardous waste code(s)

3. A discussion of the time period of use, dimensions, capacity, topography, soil types (as appropriate), copies of past spill reports, and any other relevant information

4. A copy of the most recent Part A permit application, if applicable

Plans for total closure must address all units at the facility. Plans for partial closure should indicate which units are to remain active. This information should also be indicated on the facility's Part A permit application.

The closure plan should state *verbatim* the Closure Performance Standard in 40 CFR 265.111 or 264.111.

2.4.3 Maps and Drawings

The closure plan should provide a topographic or county map indicating the location of the facility without obscuring the features. The topographic or county map should include features within 1,000 feet of each property line of the facility. The closure plan should provide detailed maps or diagrams of the facility itself; detailed drawings of each unit to be closed; and cross sectional drawings of secondary containment systems, landfills, and surface impoundments. Topographic features, well locations, and surface water run-on and run-off directions should be discussed or included on the detailed maps, drawings, and diagrams.

Detailed maps or diagrams of the facility itself should also include, but not be limited to, the following information:

1. Map scale and date

2. Orientation of the map (north arrow)
3. Legal boundaries of the facility
4. Access control (fences and gates)
5. Surrounding land uses (residential, commercial, agricultural, and recreational)
6. On-site buildings and structures, including the entrances and exits of each
7. Locations of each on-site hazardous waste management unit, including clear identification of units undergoing closure
8. The USDA SCS soils survey map of the area surrounding the units

Detailed drawings of each unit to be closed should also include, but not be limited to, the following information:

1. Drawing scale and date
2. Orientation of the drawing (north arrow)
3. Dimensions, entrances, and exits of buildings or structures located adjacent to the unit undergoing closure
4. Unit dimensions
5. Appurtenant structures or equipment of the unit
6. Relationship of the unit to other points or structures on the facility property

Additional maps and drawings are discussed in Section 2.9, RCRA Soil Sampling, for soil investigation.

2.4.4 Containment Description

The closure plan should provide a detailed description of the containment of each unit undergoing closure. The closure plan should describe how the unit, including the containment, was designed and operated to prevent the migration or escape of hazardous waste, hazardous constituents, leachate, and runoff from the unit.

For container and tank storage units and incinerators, the discussion should focus on secondary containment structure features (such as walls, berms, and slope), if any, for the entire unit, including ancillary equipment, if applicable. The discussion should include items such as capacity, dimensions, age, integrity, materials of construction, joints, fittings, coatings or sealants applied to the structure, and chemically resistant water stops used at joints.

For waste piles, landfills, surface impoundments, and land treatment units, the description should provide information on the liner and the cover system (if applicable). Specifically, information should include the following:

- Liner type, composition, manufacturer, dimensions, thickness, and age
- Brief description of the original liner installation procedures, including seaming and quality assurance/quality control (QA/QC) checks
- Brief description of any liner maintenance and inspection performed after installation
- Description of the structural condition of the unit, including cracks, tears, leaks, punctures, holes, or unsealed joints or seams of the secondary containment system, liner, or cover system

If containment structures are not present or are inadequate, the closure plan should discuss the drainage features of the unit and its surroundings and where spilled waste would flow. This discussion should also describe the facility setting, including the attenuative properties of the soil between the unit, ground water, and surface water and any other factors that would influence the mobility of hazardous waste or hazardous waste constituents and their potential to migrate to ground water and surface water.

2.4.5 Hazardous Waste List

The closure plan must provide a complete, detailed list of all hazardous wastes (chemical name and the U.S. EPA hazardous waste number) treated, stored, or disposed of at each unit. Common names or trade names should not be used when generic chemical names are available. For each unit, the closure plan should indicate the total volume or weight of each hazardous waste managed on site over the active life of the facility.

2.4.6 Air Emissions

When applicable, the closure plan should specify that air emissions problems related to closure will be eliminated or minimized, including

nuisance problems such as dust or odors. Example problems include solvent emissions during remediation, transfers, and decontamination operations and dust problems related to decontamination, soil excavation, and solidification activities.

2.4.7 Personnel Safety and Fire Prevention

The closure plan should indicate that Occupational Safety and Health Administration (OSHA) and other government regulations will be followed to protect all personnel (including contractors and visitors) involved in the closure project and those who could be possibly exposed to hazardous waste by the closure activities.

2.4.8 Closure Schedule

According to 40 CFR 264.113(a) and 265.113(a), all hazardous waste must be treated, removed, or disposed of in accordance with the approved closure plan within 90 days after approval of the closure plan by IDEM or after receipt of the final volume of hazardous wastes for permitted units. Closure activities must also be completed in accordance with the approved closure plan within 180 days after approval of the closure plan or 180 days after receipt of the final volume of hazardous wastes for permitted units.

The plan should contain a timetable that shows all critical closure dates, including dates for waste removal, sampling, soil removal, critical times for the independent engineer or his or her representative to be present on site, site restoration, times for survey plat (if applicable), independent engineer's certification, and other relevant activities. This timetable should generally start at the point of closure plan approval or some other definable date and should not be based on calendar dates.

IDEM may require that the owner or operator contact OLQ before conducting certain critical activities (such as soil sampling or removal, ground water monitoring well installation, or well sampling) to allow an inspector to be present to observe these activities.

Closure time periods longer than those listed above may be granted if detailed justification is provided that meets the requirements of 40 CFR 264.113(a) or 265.113(a). Extensions of the closure period are discussed in 40 CFR 264.112(c)(2)(ii) and 265.112(c)(2)(ii), which

reference the permit modifications of 40 CFR 270.42. It should be noted that the time period for closure by removal should not exceed 3 years. If closure by removal cannot be achieved, a post-closure plan must be submitted for approval. Closure certification is due 60 days after closure completion.

2.4.9 Closure and Post-Closure Cost Estimates

The closure plan should include a closure cost estimate calculated in current dollars in accordance with 329 IAC 3.1-14-3 or 329 IAC 3.1-15-3. Closure costs should, at a minimum, include estimates for removal of inventory, decontamination, sampling and analysis, and closure certification. The costs should be based on a third party closing the facility. Closure costs should also include a contingency fee based on a percent of total costs to compensate for errors of omission and unforeseeable circumstances. For facilities that require post-closure, a separate post-closure cost estimate must also be provided in accordance with 329 IAC 3.1-14-13 and 329 IAC 3.1-15-5.

2.4.10 Financial Assurance

Financial assurance must be established for closure and post-closure based on the closure and post-closure cost estimates. Several options are available under 329 IAC 3.1-14 and 329 IAC 3.1-15 for establishing the appropriate financial mechanism. For enforcement-driven closure plans, the administration of this requirement is handled by the OLQ through the Office of Enforcement. For other closure plans, the administration of this requirement is handled solely by OLQ.

2.5 Administrative Closure Procedures

The general process for, and exceptions to, closure activities are discussed below.

2.5.1 Agency Review and Public Notice of Closure Plans

When IDEM receives a closure plan, the closure plan is logged in and assigned to a reviewer. The closure plan is reviewed for completeness and technical adequacy. If the plan is inadequate, the owner or operator is sent a Notice of Deficiency (NOD) that specifies the plan's inadequacies. The plan must be revised to address the items in the NOD and resubmitted to IDEM. When IDEM receives a complete and technically adequate plan, IDEM will approve or modify the closure plan in accordance with 40 CFR 265.112 and 264.112. Figure 2.1 presents a flow chart that outlines the closure plan review process. The number of copies of the closure plan required for review depends on the unit type undergoing closure. Guidance on the number of copies needed will be given prior to closure plan submittal.

A Public Notice is then filed in a local newspaper, and the public will be given a 30-day opportunity to submit written comments and request modifications of the closure plan. A public hearing may be conducted at IDEM's discretion.

2.5.2 Request for Administrative Review

If the owner or operator wishes to challenge a closure plan modification that has been made by IDEM for the purpose of closure plan approval, a Petition for Administrative Review and a Petition for a Stay of Effectiveness must be submitted to the Office of Environmental Adjudication within 15 days of the date of receipt of the closure plan approval letter. The petition must include facts demonstrating that one is either the applicant, a person aggrieved or adversely affected by the decision, or likewise entitled to review by law. The petition must specifically identify the portions or conditions of the modified closure plan for which a stay or administrative review is being requested. Further information on this issue is presented in IC 13-15-6 and 4-21.5-3.

2.5.3 Time Extensions During the Closure Period

Under 40 CFR 264.113 and 265.113, the Commissioner may approve an extension of the 180-day closure period if the owner or operator can demonstrate, among other things, that:

1. Closure activities will necessarily take longer than180 days to complete, and

2. The owner or operator has taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed but inactive facility.

For closures under interim status requirements, 40 CFR 265.113 (b) and (c) state that an extension of the 180-day closure period must be requested at least 30 days prior to the expiration of the 180-day period. Justification for the time extension must be provided. For permitted facilities undergoing closure, 40 CFR 264.113(d) requires that the permit be modified in accordance with 40 CFR 270.42.

As previously noted, the closure by removal time period should generally not exceed 3 years. If the facility is attempting a plume stability assessment according to RISC Appendix 3, or if the risk assessment requires longer than 3 years to complete, the closure period may be extended. If closure by removal cannot be achieved in the approved period, a post-closure plan must be submitted for approval.

2.5.4 Closure Plan Modifications

An owner or operator with an approved closure plan must submit a written request to IDEM to authorize a change to the approved closure plan. The written request must include a copy of the amended closure plan for approval by IDEM. The closure plan must be modified whenever unexpected events require changes to the plan.

The closure plan must be amended at least 60 days after an unexpected event has occurred that affects the closure plan. If an unexpected event occurs during the partial or final closure period, the owner or operator must amend the closure plan no later than 30 days after the unexpected event. These provisions also apply to owners or operators of surface impoundments and waste piles who intended to remove all hazardous wastes upon closure but who are required to close as landfills in accordance with 40 CFR 265.310. If the amendment to the plan is a Class 2 or 3 modification according to the criteria in 40 CFR 270.42, the modification to the plan will be approved in accordance with the procedures in 40 CFR 265.112(d)(4).

2.5.5 Closure Certification Procedures

Closure certification procedures and requirements are discussed below.

2.5.5.1 Submittal of Closure Plan and Certifications

All copies of the closure plan, certification, and any revisions (one with original signatures) should be submitted to the address below.

Section Chief
Hazardous Waste Permit Section
Office of Land Quality
Indiana Department of Environmental Management
100 North Senate Avenue
P. O. Box 6015
Indianapolis, IN 46206-6015

2.5.5.2 Signatory Requirements

The closure plan application, revisions, and reports are subject to the signatory requirements of 40 CFR 270.11. The application must be signed as follows:

1. For a corporation, by a responsible corporate officer defined as follows:

    a. A president, vice president, treasurer, or secretary of the corporation in charge of a principal business function or any other person that performs a similar policy or decision-making function for the corporation, or

    b. The manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures

2. For a partnership or sole proprietorship, by a general partner or the proprietor, respectively

3. For a municipality, state, federal, or other public agency by either a principal executive officer or ranking elected official defined as follows:

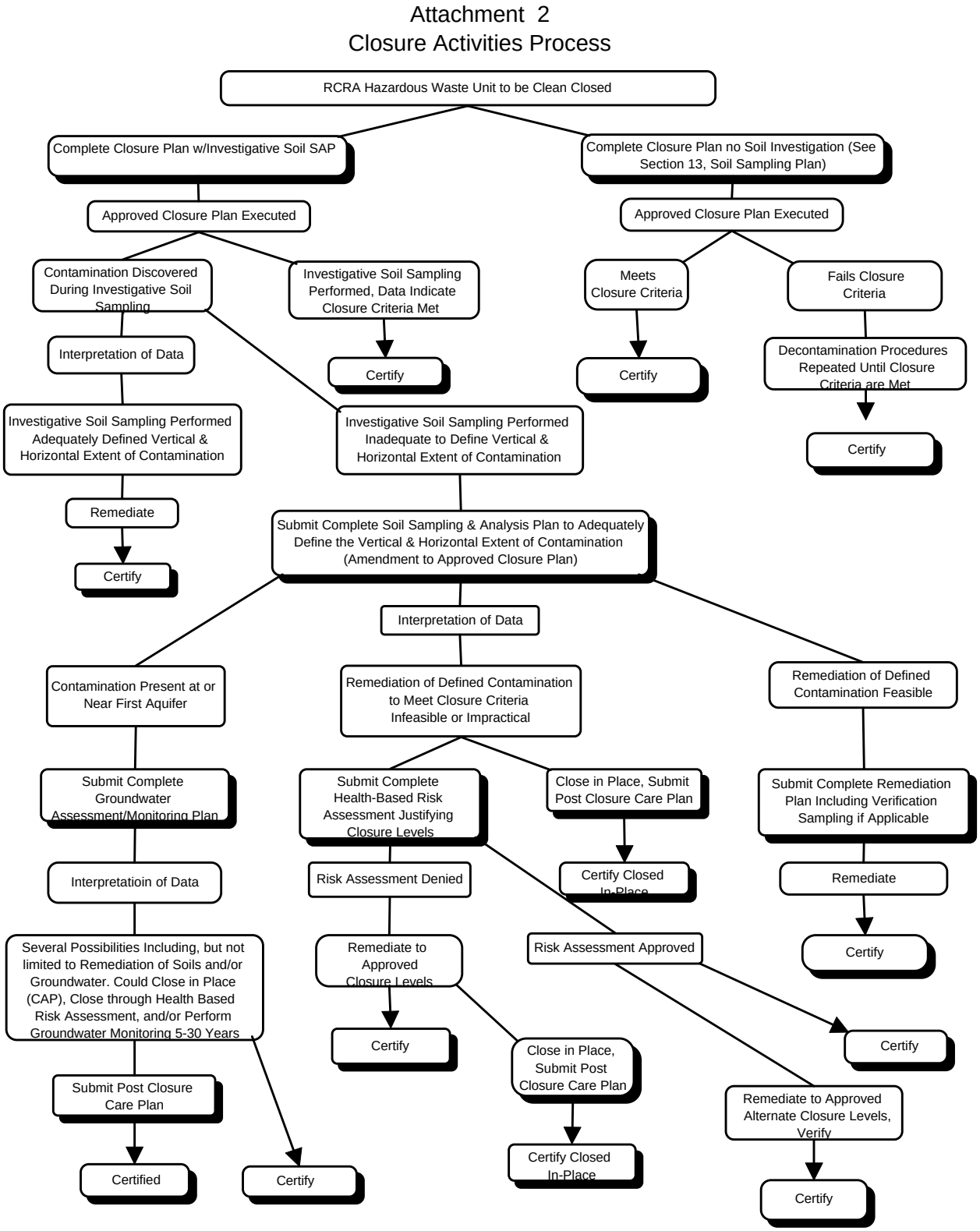
   a. The chief executive officer of the agency, or

   b. A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (for example, U.S. EPA regional administrators)

A duly authorized representative can also sign the application, but a written authorization must be signed by the appropriate officer as defined above, and the authorization must be on file with IDEM.

The Closure Plan Certification Statement in Appendix 2.1 should be signed. At least one of the copies of the certification submitted to IDEM must have original signatures. Certification of closure constitutes a report as defined by 40 CFR 270.11(b). Therefore, the certification must conform with associated signatory requirements. The certification must be signed by the officer described in this section as well as a registered professional engineer (see "Certification of Closure" below).

Figure 2-1. Closure Activities Process



2.5.5.3 Certification of Closure

All partial or total closures of hazardous waste management units must be certified by both the owner and operator and an independent registered professional engineer in accordance with 40 CFR 264.115 and 265.115. Certification is due 60 days after completion of closure activities and no more than 240 days from the date of closure plan approval (unless otherwise approved).

The independent engineer should be present during all critical, major closure activities. The independent engineer or the facility owner or operator may be required to notify IDEM in advance of any critical closure activity. These activities can include soil sampling, remediation, final cover placement, and other events. The frequency of inspections by the independent engineer should be sufficient to determine the adequacy of each critical activity. The responsibilities of the certifying engineer during closure are discussed in the preamble of the May 2, 1986, *Federal Register* amending the closure and post-closure requirements of 40 CFR Parts 264 and 265.

A closure report should be submitted with the Closure Certification Statement (see Appendix 1.4). This report should include, but not be limited to, the following information:

1. Volume or weight of waste and waste residue removed
2. Method of waste handling and transport
3. Waste manifest numbers or copies of manifests from waste removal and waste residues
4. Sampling and analytical methods used
5. Chronological summary of closure activities
6. Closure costs
7. Photographic documentation of closure
8. Analytical results

All analytical results must include the information listed in Section 2.8.3 in order to be validated by IDEM. For partial closures, revised cost estimates for remaining closure activities and any affected financial assurance instruments should be submitted with the closure certification documents. If the certification is for total closure, the certification documents should include a request for release from financial assurance.

A completed Closure Certification Statement (Appendix 2.2) should be included with the certification report.

2.5.5.4 Status of Facility after Closure

The closure plan (Appendix 1.4) and Closure Certification Statement (Appendix 2.2) should clearly state the status of the hazardous waste facility after closure is completed. For example, the plan and certification should state if a storage facility is to be operated as a generator (less than 90-day accumulation). The plan should also describe whether closure is partial or total. If closure is partial, the plan or certification should name both the units covered by the closure plan or certification as well as units remaining in operation or covered by the permit. The plan or certification should indicate whether the facility will continue to be permitted or if the facility status would be changed to a generator or transporter (if applicable).

The plan or statement should also indicate which of the statements presented below describes the intended use of the facility.

1. The facility will continue to be permitted.
2. No TSD activities will occur at the facility.
3. The facility will continue to treat or store hazardous wastes under interim status requirements.
4. The facility will be a small-quantity generator of less than 1,000 kilograms per month of hazardous waste and accumulate the hazardous waste on site for less than 90 days.
5. The facility will generate more than 1,000 kilograms per month and will accumulate the hazardous waste on site for less than 90 days.
6. The facility will generate more than 100 kilograms per month, but less than 1,000 kilograms per month and accumulate the hazardous waste on site for less than 180 days (or 270 days, if applicable).
7. The facility will be exempt from TSD regulation under RCRA.
8. The facility will be a transporter of hazardous waste.

2.5.5.5 Part A Permit Modification and Withdrawals

This discussion applies only to facilities with permits or interim status. This discussion does not apply to facilities that are required to close by an enforcement action or other means and that did not have interim status.

The facility's Part A permit application must be revised in accordance with 40 CFR 270.71 when closure certification is submitted. Responsibility for a closed unit cannot be terminated completely upon closure. In the case of total closure that requires no post-closure care, the owner/operator should submit a letter requesting withdrawal of the Part A permit application to the IDEM, along with their closure certification.

For partial closure, a revised Part A permit application must be submitted to include only the remaining units and, if necessary, a corrected copy of the existing Part A permit. A cover letter discussing the closure and explaining the changes should also be included. Facilities should modify Part B permits in accordance with the requirements specified in 40 CFR 270.42.

2.6 Closure Options

Closure can be achieved in two ways:
1) by removal or decontamination, or
2) in-place.

Closure by removal or decontamination can be achieved in two ways:
1) clean closure, or
2) risk-based closure.

Clean closure levels are established as background levels or EQLs for the constituents set forth in 40 CFR 261, Appendix VIII. Risk-based closure is based on a default or non-default risk assessment that uses exposure assumptions consistent with the land use (i.e. residential or industrial). Table 2-1 below summarizes closure options.

Table 2-1. Summary of Closure Options

Closure Types	*Removal or Decontamination*			*Closure In-Place*	
	Clean	*Residential*	*Industrial*	*Contamination in Place (waste removed)*	*Land Disposal Units (waste remains)*
Closure Levels	*Background or EQL*	*RISC Default or Non-default*	*RISC Default or Non-default*	*Site Specific*	*NA*
Post Closure Activities	*None*	*None*	*None**	*See Section 2.6.3.1*	*See Section 2.6.3.2*

**** A restrictive covenant with land use and/or activity controls required***

2.6.1 Closure by Removal or Decontamination

2.6.1.1 Decontamination Procedures

Before decontamination, all paved areas, concrete pads, containment systems, structures, and sumps should be visually inspected to identify any cracks, gaps, spills, stains, or damaged areas that may be present. This visual inspection should be documented in the closure certification report with notations of any identified problems. Any cracks, gaps, or damaged areas should be repaired by grouting or sealing before decontamination is performed in order to prevent the further release of contamination into underlying soil.

Decontamination of paved areas, containment systems, and sumps should include the following:

- Visual inspection
- Waste removal

- Mechanical cleaning (scraping or sweeping)
- Repair of damaged or unsealed areas
- Low-volume, high-pressure washing (can include steam or detergent for more effective cleaning)
- Three successive low-pressure ambient-temperature water rinses
- Sampling and analysis of final rinsate to confirm decontamination

The first two water rinses described above should remove both residual wastes and any detergents used during washing. The third or final rinse should provide the source of verification samples. Verification of decontamination must be provided to confirm that closure levels have been met.

At least two samples of the final rinsate from each unit undergoing closure should be analyzed for the hazardous constituents identified in the waste as defined in 40 CFR 261, Appendix VIII, or for hazardous waste constituents as defined in 40 CFR 260.10. The two rinsate samples are field duplicates for the rinsate. The final rinsate samples should be representative of the entire final rinse. Rinsate samples to be analyzed for metals should be filtered to remove solid particles prior to sample preservation. Whenever applicable, procedures for minimizing loss of volatile organic compounds (VOC) during sampling should be described in the closure plan.

Minimum closure levels for the rinsate that should be achieved for closure by removal are discussed further in Section 2.9.1.2 below. Decontamination procedures will be repeated until closure levels are met. If closure levels are not met after two iterations of decontamination procedures, IDEM will provide further guidance. Specific decontamination procedures for typical closure by removal projects are discussed below.

Decontamination of Equipment, Structures, and Pads

In accordance with 40 CFR 264.114 and 265.114, the closure plan should describe all efforts to (1) remove hazardous waste, its residues,

and hazardous waste constituents from tanks or (2) decontaminate paved areas, concrete pads, containment systems, equipment, structures, pipes, pumps, sumps, and any other appurtenances to the hazardous waste management unit. IDEM may request the owner or operator to use any reasonable means to clean or decontaminate the unit and its ancillary equipment, including scraping, pressure washing, solvent washing, and other means. Any equipment, including heavy earth-movers or small tools, should be scraped and washed to remove waste residues. These residues should be managed as hazardous waste, and the procedure for cleaning and managing them should be described in detail in the closure plan.

Storage pads should be decontaminated in accordance with the procedures specified in 40 CFR 264.112(b)(4). A typical pad decontamination procedure is presented below.

1. All wastes are removed from the pad and appropriately disposed of.

2. The pad is mechanically cleaned by scraping, sweeping, or other methods to remove all physical contamination.

3. The pad is inspected for cracks. If cracks are detected, items 10 and 11 may be performed at this point.

4. The cracks are sealed.

5. The pad is washed using a high-pressure steam cleaner with detergent or appropriate solvent to remove previously stored waste materials.

6. The pad is rinsed three times with water. Low-pressure, ambient-temperature rinses should be used.

7. The third (final) rinsate is collected separately, and two samples are analyzed to show that the pad's surface meets closure levels. For inorganic and certain organic parameters, closure levels will be based on the MCLs of the National Primary Drinking Water Regulations (40 CFR 141) in the rinsate. For organic parameters without MCLs, the closure levels of the rinsate will be based on the EQLs of the analytical methods as defined in SW-846. Analytical parameters will be based on wastes previously stored in the area.

8. Care is taken to prevent the migration of cleaning liquids from the pad area.

9. All residues and rinsates are collected and disposed of as hazardous waste unless the residues and rinsates are analyzed and determined to be non-hazardous.

10. Soil underlying cracks discovered during visual inspection is sampled for contamination. If contamination is found, the vertical and horizontal extent of the contamination should be determined. Closure levels for soil are based on background levels for inorganic parameters and the EQLs of the analytical methods as defined in SW-846 for organic parameters, or the RISC closure levels. Background levels for inorganics are determined by sampling soil borings in four locations known to be located in an area unaffected by facility operations. Each boring will be sampled at the same depth intervals as the soil samples collected from under the pads. The 95% upper confidence limit (UCL) of the mean is calculated to be the cleanup level for each inorganic parameter for each pad depth interval.

11. Soil that does not meet cleanup levels is remediated or removed.

12. The pad is cleaned until closure levels have been met.

Tank Decontamination Procedures

Tanks containing hazardous waste are subject to all reasonable means of decontamination in order to meet closure levels. Procedures for decontamination include manual sludge removal, pressure or solvent washes, rinses, and other procedures. An independent, registered professional engineer should certify the methods used and that the level of decontamination is appropriate for each tank's final disposition (for example, disposal as a hazardous waste or storage of product). Tanks that will be reused after closure for product storage or storage of a different hazardous waste, and tanks to be dismantled for scrap metal, require decontamination. Tanks to be dismantled and disposed of as hazardous waste may not require decontamination but are subject to Land Disposal Restrictions (40 CFR 268). Some tank

closures require a contingent post-closure care plan (see 40 CFR 264, Subpart J, and 40 CFR 265, Subpart J).

Tanks that will be used for accumulation (not to exceed 90 days) of the same hazardous waste following closure should be drained, all visible contamination removed, and the tank inspected. Owners and operators of existing tank systems that will be used to accumulate hazardous waste should be aware of the assessment requirements in 40 CFR 262 and 265.191.

Underground tanks containing ignitable wastes should be removed in accordance with State Fire Marshall regulations, and underlying soil should be sampled for the hazardous waste constituents stored in the tank. Tanks containing non-ignitable hazardous waste can be abandoned in-place if they are properly decontaminated, filled, and capped, and soil testing verifies the absence of soil contamination. Soil sampling requirements are discussed in Section 2.9.

Sampling and analysis of the final rinse is required in order to confirm that closure levels have been met for tanks that are to be used after closure to store product or different hazardous waste. At least two samples of the final rinse should be analyzed for the hazardous constituents or hazardous waste constituents identified in the stored waste. The two rinsate samples are field duplicates for the rinsate. The final rinsate samples should be representative of the entire final rinse. When applicable, procedures for minimizing loss of VOCs during sampling should be described in the closure plan.

Decontamination procedures should be repeated until closure levels are met.

Care should be taken to prevent the migration of cleaning liquids from the containment area. All wash and rinse waters should be collected and managed as hazardous waste unless analysis shows that they are non-hazardous. The closure plan should describe how decontamination waste material (rinse water, decontamination equipment, personal protective equipment, and other materials) will be managed. An estimate of the volume of waste material to be generated should also be provided. Residues from listed hazardous waste must be managed as hazardous waste unless they are de-listed under the provisions of 40 CFR 260.22 or covered by the exemption of 40 CFR 261.4.

The tanks should be decontaminated in accordance with the procedures specified in 40 CFR 264.112(b)(4). A typical tank decontamination procedure is presented below:

1. All wastes are removed from the tank.

2. The tank is mechanically cleaned by scraping, sweeping, or other methods to remove all physical contamination.

3. The tank is washed using a high-pressure steam cleaner with detergent or appropriate solvent to remove previously stored waste materials.

4. The tank is rinsed three times with water.

5. The third (final) rinsate from each tank is collected separately, and two samples are analyzed to show that the tank meets closure levels. For inorganic and certain organic parameters, closure levels will be based on the MCLs of the National Primary Drinking Water Regulations (40 CFR 141). For organic parameters without MCLs, the closure levels will be based on the EQLs of the analytical methods as defined in SW-846. Analytical parameters should be based on wastes previously stored in the tank.

6. Care is taken to prevent the migration of cleaning liquids from the tank area.

7. All residues and rinsates are collected and disposed of as hazardous waste unless the residues and rinsates are analyzed and determined to be nonhazardous.

8. The tank is cleaned until closure levels are met.

2.6.1.2 Soil Remediation

The closure plan for any facility attempting closure by removal must fully describe (1) each step taken to remove waste from the units and contaminated soil from the surrounding areas or (2) each method proposed for remediation of contaminated soil.

For removal, the plan should include a description of solidification/

stabilization, accumulation of waste or reagents, equipment used, the soil removal pattern and excavation depth increments, loading areas, and any other information critical to soil removal. The plan should clearly discuss how soil will be removed, accumulated, loaded, and managed once it leaves the site. Covered and lined roll-off containers are recommended for accumulating and removing hazardous wastes. Accumulating contaminated soils on the ground is ill-advised, as this may constitute an illegal hazardous waste pile. The plan should describe backfill materials to be used. Analysis of backfill material should document that the backfill does not exceed land-use specific closure levels or otherwise violate the assumptions of the risk assessment.

Alternatively, soil containing certain hazardous waste constituents can be remediated to closure levels and allowed to remain in the unit or be placed back into the unit. Bio-remediation and soil vapor extraction of organic constituents are examples of soil remediation processes. A complete remediation plan is required to be submitted for IDEM review as a proposed modification to the approved closure plan.

The remediation plan should include the following:

- Detailed description of treatment process(es)
- Justification of applicability and feasibility of this process to this site (including discussion of site conditions and contaminants)
- Schedule of activities
- Expected timeframe to meet closure levels
- Periodic testing to verify progress
- Periodic status reports indicating progress made
- Sampling (locations and depths) and analysis procedures for periodic and final verification
- Final verification sampling and analysis to confirm complete remediation to closure levels

In addition, the remediation plan should discuss efforts to minimize air emissions, including volatiles and dust, when applicable.

A registered professional engineer should certify engineering studies and design drawings related to the remediation plan.

2.6.2 Industrial Closure

In order to provide consistency across program areas and to implement the principles of RISC, OLQ will use the approach discussed below to accept closure certification for hazardous waste management units, or to determine that no further action is required for SWMUs and AOCs. This approach is to be used at facilities where the owner or operator chooses to close to industrial levels through a risk-based decision process.

As the name implies, Industrial Closure is to be used only in locations which have been, and will remain, industrial. As addressed in the RISC Technical Guide, closure plans may use non-default risk assessments to determine site-specific industrial closure levels. Future land use and exposure assumptions must be made in the preparation of the risk assessment. Industrial areas will allow higher closure levels than residential areas, therefore, a specific set of criteria must be met to ensure that future land use and exposure assumptions used in the risk assessment remain valid.

Engineering controls are not allowed for industrial closure.

2.6.2.1 Industrial Closure Requirements

After the removal of all waste and liners, a risk assessment based on closure levels for an industrial facility can be conducted. The risk assessment evaluates the levels of hazardous constituents that remain in the soil and groundwater, and insures that the default or non-default land-use appropriate closure levels are achieved. After approval of the risk assessment, the facility can certify closure. In order for the closure certification to be accepted, the facility must maintain land use or activity restrictions, consistent with the approved risk assessment, through either a restrictive covenant or other approved mechanism (see Appendix 5 of the RISC Technical Guide). Once the site restrictions have been implemented and other elements of the approved closure plan have been successfully accomplished, the closure certification will be accepted.

The nature and extent of contamination in soil and ground water must be determined for all facilities using industrial closure levels. Facilities with multiple sources may follow the procedures described in the RISC Technical Guidance, Section 4.1, p. 4-1. In addition, ground water contamination associated with the facility must be below the default or approved non-default industrial levels at the perimeter of compliance and below the default residential levels at areas beyond the point of property control. This can be demonstrated by proving plume stability. Compliance schedules associated with these requirements will be determined in the closure plan. If at any time land-use specific closure levels are exceeded, remediation or corrective action must occur. Failure to remediate or implement corrective actions could result in an enforcement action.

If any waste or liners remain in place, or if waste and liners have been removed but contamination in excess of industrial closure levels remains in-place, either remediation, corrective action and/or appropriate engineering controls will be required. The unit is not eligible for industrial closure and must be closed in-place. A hazardous waste management post-closure permit or other enforceable document is then required. The presence of hazardous constituents at levels below the land-use appropriate closure levels does not constitute waste or contamination remaining in place.

Industrial closure can be obtained by performing remediation (for example, excavation and hauling, soil vapor extraction, or other form of remediation) for areas exceeding industrial closure levels. Once the industrial levels are met (again, based on the additional confirmation sampling and analysis plan [SAP]), the owner/operator may certify that the unit meets the industrial closure scenario.

The only restriction that must remain in effect after achieving industrial closure is to file a restrictive covenant consistent with the approved risk assessment. Such a restrictive covenant might include (1) a land use restriction (e.g. the property cannot be used for residential purposes), and/or (2) activity restrictions, if applicable (e.g. groundwater at the site cannot be used for residential consumption). In these cases, the facility must record in the local recorder's office a restrictive covenant that provides the appropriate land use and activity restrictions. No post-closure requirements, such as those applicable to land disposal units, would apply.

Future use of property subject to an industrial closure must be consistent with the exposure assumptions underlying the risk assessment. Property subject to industrial closure can be used for any legitimate future industrial use so long as the land use and exposure potential are consistent with the land use and exposure assumptions approved in the risk assessment.

2.6.2.*2* Summary of Requirements for Industrial Closure

1. The approved closure plan must be successfully completed.

2. The owner or operator performing the industrial closure must record an appropriate restrictive covenant on the property deed concerning the industrial land-use restriction. A title reference must be provided. The portion of the property covered by the deed restriction must be clearly delineated on a survey plat.

3. Owners of the property after the restrictive covenant is recorded must:
   a. comply with the terms of the covenant, and
   b. notify future buyers that the facility's use is limited and must be consistent with the terms of the restrictive covenant.

4. Before the land use can change, the owner or operator at the time the change is proposed must demonstrate that the remaining constituents meet levels consistent with the proposed use of the property. If IDEM agrees with the demonstration, the restrictive covenant may be amended or terminated to reflect current conditions.

If an owner/operator does not comply with the terms of the restrictive covenant, that owner/operator is subject to enforcement action in accordance with IC 13-14-2-6.

2.6.2.3 Notices

Sites that are closed to industrial levels are required to record a ***restrictive covenant*** in the local recorder's office. This recorded document notifies future landowners that the property meets industrial health-protective levels but is not suitable for residential use and residential activities.

Within 60 days of certification of closure of the hazardous waste management unit, the owner or operator must record, in accordance with State law, a restrictive covenant that will notify any potential future purchaser of the property that the property has been used to manage hazardous wastes and that certain restrictions apply to its use. The owner or operator must also submit to IDEM a certification signed by the owner or operator that the notation has been recorded, including a copy of the document in which the notation has been placed (see 40 CFR 264.119 and 265.119).

If in the future the owner/operator wishes to demonstrate that the levels of constituents left in place meet the residential closure levels, a supplemental sampling and analysis plan for verification sampling must be sent to the IDEM for approval. A separate closure certification must then be submitted, stating that the verification sampling now indicates that the site meets residential closure levels. Following IDEM acceptance of the revised closure certification, the restrictive covenant may be amended or terminated.

2.6.3 Closure in Place

2.6.3.1 Closure with Contamination in Place

In some cases, after the waste or liners are removed, contaminants may remain which exceed land-use specific closure levels. In these cases, the closure is not considered a closure by removal or decontamination, but is considered a closure in place. Where engineering controls or physical barriers (i.e. something more than a restrictive covenant) are needed to meet the land use specific closure levels, an enforceable document is needed to ensure that the engineering control or physical barrier remains in place.

Limited post-closure care may be warranted, dependent upon the facts and circumstances of each case. In some cases, physical engineering controls (e.g. caps, fences, buildings) must be maintained to ensure that the land use and exposure assumptions made in the approved risk assessment remain valid. In other cases, appropriate groundwater monitoring schedules may need to be established. In these cases, the details and duration of the facility's post-closure requirements (stipulated in an order or post-closure permit) could be tailored to the specific facts and engineering controls being utilized. In some situations, it may be appropriate to combine monitoring or other features with other closure or corrective action activities at the facility. For example, the monitoring of a particular unit may be combined in some circumstances with an overall program in corrective action.

Facilities utilizing engineering controls to prevent exposure will require an order or post-closure permit which will include the stipulation that the control must be maintained appropriately and if damaged or rendered ineffective, must be repaired or replaced with other effective controls.

2.6.*3.2* Closure In-Place - Land Disposal

Any unit where waste is to be left in place (such as landfills, tanks unable to achieve clean closure, waste piles, and surface impoundments to be closed as landfills) has several additional important considerations beyond those required for closure by removal or decontamination. These considerations include liners, final cap cover, vegetation, ground water monitoring, post-closure care, and permit requirements.

Full descriptions and detailed engineering drawings are required for each unit undergoing closure in-place. Details of liners, drainage layers, covers, vegetation, wells, final contours, construction QA, or any relevant structures or practices should be provided. A registered professional engineer should certify engineering studies and design drawings and specifications.

Several additional regulatory requirements for closed disposal units are specified in 40 CFR 265.197, 265.228, 265.280, and 265.310 for facilities. The requirements concern ground water monitoring, post-closure plans, post-closure care, notice to local land authority, and notice in the deed to property. More information on groundwater monitoring requirements is presented in 40 CFR 264 Subpart F and 265 Subpart F, and more information on post-closure care and notices is presented below.

2.6.3.3 Post-Closure Care

The closure plan for any disposal unit must include a post-closure care plan in accordance with 40 CFR 265.117. For land disposal units that close after May 19, 1981, an application for a post-closure care permit must be submitted upon request from IDEM. Tank systems that do not have secondary containment must follow the procedures for post-closure care outlined in 40 CFR 265.197.

2.6.3.4 Location Documentation for Disposal Units

There are three notification requirements for facilities that close units in place with post-closure care. First, 40 CFR 265.116 states that at no later than the submission of the certification of closure of each hazardous waste disposal unit, an owner or operator must submit to the local zoning authority or county land-use authority and the IDEM Commissioner a survey plat indicating the locations and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks. This plat must contain a note indicating the owner's or operator's obligation to restrict disturbance of the hazardous waste disposal unit in accordance with 40 CFR Part 265, Subpart G, regulations.

A copy of the survey plat and a copy of the document with the notation required by 40 CFR 265.116 must also be provided to the IDEM along with the closure certification.

Second, 40 CFR Part 265.119(a) states that within 60 days of certification of each hazardous waste disposal unit, the owner or operator must submit to the zoning authority or county land-use authority and the IDEM a record of the types, locations, and amounts of hazardous wastes disposed of within each cell.

Third, 40 CFR Part 265.119(b) states that within 60 days of certification of closure of the first and last hazardous waste disposal units, the owner or operator must record a notice in deed that the land was used to manage hazardous waste and must not be disturbed, and certify that this information was recorded and a copy of the information sent to the IDEM.

2.6.3.5 Certification of Completion of Post-Closure Care

Within 60 days after the completion of the established post-closure care period for each hazardous waste management unit, a certification must be submitted to IDEM that the post-closure care period for the hazardous waste unit was performed in accordance with specifications in the approved post-closure plan. The certification must be signed by the owner or operator and an independent, registered professional engineer. Documentation supporting the independent registered professional engineer's certification must be furnished to IDEM upon request until the owner or operator is released from the financial assurance requirements for post-closure care under 329 IAC 3.1-14 or 15.

2.7 RCRA Corrective Action Process

Facilities seeking a TSD permit and facilities that formerly operated as TSDs that released hazardous constituents must fulfill certain Corrective Action requirements, in accordance with Indiana Code 13-22-2-5(6) and 13-22-13-1. IDEM may initiate Corrective Action either through the RCRA permit, if applicable, or through an order. Alternatively, facilities may choose to address Corrective Action obligations voluntarily (for example, through either an agreed order or the VRP with accompanying order). Regardless of how a facility enters corrective action, the goals are the same—facility-wide assessment for the presence of released hazardous waste and/or

hazardous constituents followed by a demonstration that any such release at or from the facility does not pose unacceptable risks to human health or the environment.

The Corrective Action process consists of five basic elements:

- Potential source identification
- Release assessment
- Release investigation
- Evaluation and selection of appropriate remediation technology or technologies
- Remediation of release(s)

These elements typically occur, to some degree, during most cleanups. They should be viewed as evaluations needed to make good cleanup decisions, not necessarily individual steps through the process. All five elements are briefly described below. Specific details are provided in the "Corrective Action Scope of Work," which is available from IDEM.

Either a default or non-default risk assessment can be performed after either the release assessment or the release investigation, or upon completion of remediation activities. Upon satisfactory completion of corrective action requirements, IDEM will issue an acknowledgment that no further action (NFA) is required for the unit at this time. Closure under the RISC Technical Guide can be used to demonstrate that the unit has attained no further action status.

IDEM recognizes recent reforms by the U.S. EPA to "streamline" Corrective Action. For facilities that meet EPA's qualifying criteria, the IDEM will incorporate a streamlined Corrective Action process into permits and orders. In accordance with the streamlined approach, IDEM emphasizes that the details contained in the Corrective Action Scopes of Work referred to above should not be considered boilerplate provisions applicable to every site, but rather a menu of possible activities that may be appropriate for a particular facility or corrective action evaluation. Similarly, facility owners and operators are encouraged to pursue interim corrective measure and presumptive remedies to accelerate the process of environmental improvement.

2.7.1 Potential Source Identification

During this stage of the process, the entire facility is evaluated for its potential to release hazardous wastes and hazardous constituents into the environment. The potential source identification is similar to the pre-sampling discussed in Chapter 2 of the RISC Technical Guide. This evaluation is commonly referred to as the RCRA facility assessment (RFA). If the RFA reveals that the potential for releases exists or existed, a current conditions report is required for the facility that includes the following information:

- A summary of the facility's background, including the historical use of the facility and all known locations where solid or hazardous wastes were managed**,** regardless of when they were in use

- A description of the known nature and extent of any contamination, including available monitoring data, potential migration pathways, and potential receptors

- A description of any measure that was or is being undertaken to mitigate any risks to human health or the environment

2.7.2 Release Assessment

Release assessment is the first of two steps in the Corrective Action RCRA facility investigation (RFI) process. The default procedures for this assessment follow the screening procedures described in Chapter 3 of the RISC Technical Guide**.** This assessment normally requires a work plan submitted for IDEM approval, unless IDEM has approved an alternate approach. Two additional requirements apply to the release assessment beyond those presented in Chapter 3 of the RISC Technical Guide. First, the owner/operator must submit a community relations plan (CRP). The CRP will describe how the community will be kept apprised of conditions and ongoing work at the facility. Secondly, if an imminent threat to human health or the environment is discovered during the release assessment, interim measures are required to abate the threat.

2.7.3 Release Investigation

Release investigation is the second of two steps in the RFI process. It is similar to characterization of the nature and extent of contamination discussed in Chapter 4 of the RISC Technical Guide. However, the owner/operator should refer to this chapter's Sample Quality Assurance and Analytical Requirements, RCRA Soil Sampling, and RCRA Ground Water Evaluation sections for guidelines that are used in the RCRA program. Results of the release investigation and release assessment are usually presented in an RFI report.

2.7.4 Evaluation and Selection of Appropriate Remediation Technology

Upon IDEM's approval of the results of the release investigation, IDEM may require the evaluation of remediation technology alternatives. This evaluation is commonly referred to as a corrective measures study (CMS). The CMS's objective is to ensure that any technology ultimately selected will be capable of effectively achieving timely closure. The technology or technologies will also be evaluated for cost-effectiveness. It is important to note that "cost-effective" does not necessarily mean the least costly.

Evaluation of appropriate remediation technologies need not be a lengthy process. A presumed remedy (that is, a known, proven remedy) that meets the effectiveness and timeliness criteria can be proposed to IDEM. Regardless of how the potential remedy is chosen, its proposal must be made available for public comment.

2.7.5 Remediation of Releases

Upon termination of the public comment period, IDEM will select the remedy or combination of remedies to be implemented. Under the Corrective Action process, this element is called "Corrective Measures Implementation." Once the remedy is selected, the owner or operator must demonstrate financial assurance through one or more of the following mechanisms:

- Trust fund
- Surety bond guaranteeing performance

- Letter of credit
- Financial test
- Corporate guarantee

Insurance and surety bonds guaranteeing payment into a standby trust fund are not acceptable mechanisms (see 55 FR 30856, July 27, 1990).

2.7.6 "No Further Action" Status

For SWMUs and AOCs, there are two ways of achieving no further action at this time (NFA) status: either remediation of any releases to background concentrations or demonstration that the concentrations of contaminants remaining will not pose threats to human health or the environment.

2.7.6.1 Remediation to Background Concentrations

No further action at this time under this scenario requires investigation of releases from SWMUs and AOCs and remediation to background levels (or EQLs for organic compounds) of any media contaminated by a SWMU or AOC.

2.7.6.2 Demonstration of Insignificant Threats to Human Health and the Environment

No further action at this time under this scenario requires investigation of releases from SWMUs and AOCs and evaluation of the collected data using appropriate risk assumptions to verify that no media present threats to human health and the environment. Remediation of affected media may be necessary to meet the concentrations established by the risk assessment.

For any risk assessment that uses an industrial exposure assumption, the owner or operator must record a restrictive covenant on the affected property's deed (see IC 13-25-4-24), which limits the use of the property and/or the activities at the property consistent with the approved risk assessment. Additional requirements are discussed in Appendix 5 of the RISC Technical Guide.

2.8 Sample Quality Assurance and Analytical Requirements

The sample QA and analytical requirements apply to the soil and ground water sampling discussed in Sections 2.9 and 2.10 of this User's Guide. SAPs, sample QA, and analytical requirements are discussed below.

2.8.1 Sampling and Analysis Plans

An adequate SAP should include, at a minimum, the following information:

1. Media to be sampled
2. Parameters to be analyzed
3. Sampling locations and depths
4. Background boring locations and depths for inorganic parameters (if applicable)
5. Soil boring methods, sample collection methods, and sampling equipment
6. Procedures and equipment used to minimize volatilization in samples submitted for organic analysis
7. Sample preservation techniques and containers
8. Equipment decontamination procedures
9. Analytical procedures used to achieve EQLs
10. Statement indicating closure levels
11. Sample chain-of-custody control procedures, including shipping procedures
12. A copy of the form that will be used to record and document soil descriptions and sampling information in the field

The form identified under item 12 above should include the following information:

1. Facility or unit
2. Purpose of sampling
3. Sampling date and time
4. Weather conditions
5. Field personnel
6. Sampling method and equipment
7. Boring, test pit, or well location and identification (ID) number

8. Soil mapping unit determined from the appropriate county soil survey published by USDA's SCS
9. Sample number
10. Sampling interval and depth
11. Monitoring well static water level
12. Monitoring well purging procedure
13. Ground water field measurements (such as pH, specific conductance, and temperature)
14. USDA soil textural classification from the following reference: USDA. 1962. *Soil Survey Manual*. Handbook No. 18. U.S. Government Printing Office. Washington, DC.
15. Lithology
16. Munsell soil color from the following reference: Munsell Color. 1975. *Munsell Soil Color Charts*. Baltimore, MD.
17. Sedimentologic features
18. Miscellaneous observations
19. Evidence of contamination (such as discoloration, odor, or field instrument results)

Facilities are strongly advised to perform continuous soil borings and record descriptions in accordance with IDEM's Unconsolidated Descriptive Requirements.

2.8.2 Sampling Quality Assurance

Sampling methods and equipment used should follow guidance in U.S. EPA's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846) and U.S. EPA's "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" (OSWER Directive No. 9950.1, Final, 1986). Field sampling methods not included in SW-846; 40 CFR 261, Appendix I; or the technical enforcement guidance document must be approved by OLQ before use. These methods include drilling, boring, and other sampling methods. When available, standard procedures as defined by U.S.EPA, IDEM, or the American Society for Testing and Materials (ASTM) should be followed.

IDEM recommends using the Data Quality Objective (DQO) process for all sampling and analysis performed in support of RISC. DQO's establish the type, quality and quantity of data required to make and defend a particular decision. See Section 3.2.1 of the Technical Guide for information on the DQO process. IDEM highly recommends

collecting the various types of quality assurance samples. Each QA sample documents specific aspects and provides information about accuracy or precision throughout the sampling process. Proper decisions cannot be made without appropriate QA samples, and analytical results will be considered to be estimated, attributed to the sample, or may not meet the project DQO.

For each batch of 20 samples or less, IDEM recommends at least one field duplicate per matrix type must be collected. Control samples such as trip blanks (when VOC's are chemicals of concern) or equipment blanks (to demonstrate field decontamination procedures) should be collected for each day that samples are collected. In addition, for each batch, sufficient sample amounts must be collected of each matrix to allow the laboratory to prepare one matrix spike and either one matrix duplicate analysis or one matrix spike duplicate per analytical batch when appropriate for the method. The purpose of matrix spikes is to determine bias resulting from the sample matrix. Therefore, the spiked sample must be from the same project as the field samples. If the spiked sample is not from the same project, analytical results must be flagged as estimated. Samples identified as blanks do not meet the purpose of a spike and must not be spiked.

Samples collected for VOC analyses require specialized sampling and handling procedures. Soil samples should be collected with a split-spoon sampler or a sampler that uses removable liners made of stainless steel or some other material acceptable to the laboratory. IDEM recommends Indiana modified method IN-5035M for collecting soil samples for VOC analysis. Preparation, decontamination, and sampling procedures should be performed in accordance with SW-846 and U.S. EPA's technical enforcement guidance document. Under no circumstances should soil samples for VOC analysis be mixed, composited, or otherwise aerated.

2.8.3 Analytical Requirements

A complete quality assurance project plan (QAPP) should be prepared to document sampling and analytical requirements. Guidelines for developing a QAPP are presented in Chapter 3 of the RISC Technical Guide as well as SW-846, Chapter 1. Chapter 3 of the RISC Technical Guide also details the data quality objectives (DQO) process. One project objective is that the analytical methods' EQLs meet closure levels. Appendix 2 of the RISC Technical Guide contains guidance on choosing analytical methods that will meet project objectives.

The QAPP should also specify analytical methods for each parameter, sample preparation and extraction methods, and EQLs for each analyte. Guidance for establishing EQLs, which are highly matrix-dependent, is provided in SW-846. The analytical methods in SW-846 should be used whenever possible. Other official U.S. EPA methods applicable for the sample matrix can be used, but any modification to these methods or the use of any other methods will require the submittal of the complete method for OLQ approval. The QA requirements specified in the individual methods must be performed by the laboratory to produce data of acceptable quality.

The use of common field screening instruments, such as combustible gas indicators, colorimetric indicator tubes, and photo-ionization detectors (such as the HNu™ or TIP™), is not an acceptable substitute for SW-846 methods. These screening tools can be used to determine the presence (but not the absence) of hazardous constituents. They are only appropriate and acceptable for screening samples. If portable field instruments are used, the results should be confirmed by laboratory analysis of the samples using SW-846 methods.

Reports that contain analytical results should include the information specified in IDEM's "Hazardous Waste Program: Analytical Data Deliverable Requirements for RCRA Closures, Risk Assessments, Site Assessments, and Remediation Projects." The information is necessary to allow data review and validation.

The document "Guidance to the Performance and Presentation of Analytical Chemistry Data" contains additional guidance on the DQO process, QAPP preparation, and analytical requirements.

2.9 RCRA Soil Sampling

This section discusses soil sampling under the RCRA program, including the following:

- Soil sampling requirements
- Background sampling
- Sampling considerations
- Sampling to determine the nature and extend of contamination

- Closure or verification sampling
- Industrial closure soil sampling

2.9.1 Soil Sampling Requirements

Hazardous waste management units having any evidence or possibility of a release or the potential for migration of a hazardous waste or hazardous constituent (see 40 CFR 261, Appendix VIII) at any time during the life of the unit must be investigated before closure (Chapter 3 of the RISC Technical Guide). Soil, and potentially ground water, should be investigated to determine the presence of hazardous constituents. For Corrective Action purposes, the investigation must evaluate for the presence of hazardous constituents. Investigation is required for container or tank storage areas located on soil, gravel, paved pads, or concrete pads. However, IDEM may, on a case-by-case basis, determine that alternate sampling is appropriate. Sampling should be performed in accordance with the sampling methods listed in 40 CFR 261, Appendix I, or SW-846, Chapter 9.

If soil is found to be contaminated, the closure plan, post-closure care plan, or corrective action provisions, if applicable, may require ground water monitoring to determine the nature and extent of contamination. Ground water monitoring applicable by regulation (40 CFR 264.90 and 265.90) has specific standards, and the closure plan must account for these standards (see Section 2.10 of the User's Guide and Chapter 6.3.3 of the RISC Technical Guide for ground water monitoring requirements).

Constituent evaluation, closure levels, and screening sample locations are discussed below.

2.9.1.1 Constituent Evaluation

Parameters for soil analysis should include elements or compounds of the hazardous wastes, hazardous constituents (40 CFR 261, Appendix VIII), or hazardous waste constituents (as defined in 40 CFR 260.10). The owner or operator or IDEM can propose parameters. For Corrective Action purposes, the initial parameter list is comprised of any hazardous constituent used at the facility, as well as any breakdown product or by-product of a hazardous constituent used at the facility. With sufficient justification, parameters can be eliminated

during SAP preparation. Parameters can also be eliminated depending on sampling results (see Chapter 3 of the RISC Technical Guide).

Parameters should be determined not only based on knowledge of wastes managed at the unit but also on other potential elements or compounds used at the facility that generated the waste. These considerations are similar to those used by U.S. EPA for waste de-listings. For example, soil underlying a surface impoundment containing F006, electroplating wastewater treatment sludge, could also be analyzed for 1,1,1-trichloroethane, a solvent likely to be used at a plating facility. IDEM may also require additional parameters for analysis, such as breakdown products.

2.9.1.2 Closure Levels

Closure requires analysis of final rinsates from the decontamination of pads, tanks, or structures to determine if the waste has been removed. Rinsate analytical results must meet (1) the MCLs of the National Primary Drinking Water Regulations (40 CFR 141 and 40 CFR 264.94[a][2]) for inorganic and certain organic parameters with MCLs and (2) estimated quantitation limits (EQLs) as defined by SW-846 for the organic parameters without MCLs. RISC default closure levels are not appropriate for rinsates because the decontamination demonstration is not based on exposure.

Default closure levels for soil and ground water are listed in the RISC Technical Guide, Appendix 1 Table A. These closure levels are based on appropriate land use.

Closure levels for soil can also be established using the non-default procedures presented in Chapter 7 of the RISC Technical Guide. The alternate cleanup level proposal must document that the constituents left in soil will not adversely impact any other environmental medium (ground water, surface water, or atmosphere) and that direct contact through dermal exposure, inhalation, or ingestion will not result in threats to human health or the environment.

Closure levels for soil can be the analytical methods' EQLs for organic compounds and background levels for inorganic compounds. Background levels for inorganic compounds are calculated as the mean

plus one standard deviation. If the coefficient of variation for the background samples exceeds 1.2, additional sampling may be necessary. (See Section 1.6 of the Technical Guide).

2.9.1.3 Screening Sample Locations

Locations of screening soil borings and samples should be selected to determine with a high level of confidence whether any of the identified constituents are present. Random sampling can be performed using a grid system. Directed sampling using the default procedures specified in Section 3.4.1 and Section 3.4.2 of the RISC Technical Guide should be performed in areas of suspected contamination (such as cracked areas of a containment structure, areas of known spills, and suspected downslope, downwind, or runoff areas of a containment structure).

Other directed or systematic methods (such as sampling at uniform intervals) can be used if warranted on a site-specific basis. These methods may include a circular pattern of sampling around a central point or linear sampling along the drainage way, boundary, or perimeter of a container storage area. Grid sampling and directed sampling can both be used in the same closure plan. Section 3.4.1 of the RISC Technical Guide discusses procedures for choosing sampling locations based on a random grid pattern.

2.9.2 Background Sampling

Determination of background concentrations is only necessary to establish closure levels (for example, when natural soil concentrations exceed closure levels) or to determine the vertical extent of contamination for organics. Section 1.6 of the RISC Technical Guide provides details on background sampling.

All background boring locations should be adequately justified and are subject to approval and modification. Proposed background boring locations must be shown on a detailed map or diagram of the facility. Any deviations from the SAP resulting from problems encountered in the soil or based on knowledge of the area should be adequately justified and will be subject to review. Background soil sample results may also be subject to approval if the concentrations are not typical of local Indiana soil.

2.9.3 Sampling Considerations

The risk assessment process requires developing an overall project goal, developing a conception of the facility (a "conceptual site model"), collecting data (research or analytical) to support or enhance the conceptual site model, and evaluating the results. Physical sampling of the facility is only part of the process. Sampling results may indicate the need to collect further data. The sampling process may go through several rounds requiring planning, data collection, and evaluation. It is possible that the project goal may change when more information becomes available during this iterative process. Throughout the process, the owner or operator should consider what types of sampling will be required to collect the data needed to make a final evaluation.

The RISC site evaluation process is summarized in Table 2-2 below.

Table 2-2. RISC Three-Step Site Evaluation Process

Step	Purpose	Comment
Screening	To determine if additional investigation is needed	Can include judgmental (directed) or random soil sampling as well as ground water screening
Determining Nature and Extent of Contamination	To identify contamination boundaries and amounts	May indicate that remaining constituents pose acceptable risks or that remediation is necessary
Verification of Closure Sampling	To confirm that remediation is complete	Must be repeated until closure levels are met

Area screening is optional. If an area is known to be contaminated, the owner or operator can proceed to determining the nature and extent of contamination or to remediation (for example, excavation of the area). Remediation requires adequate closure verification sampling results.

The owner or operator should consider all media when developing the conceptual site model. The SAP should detail the sampling strategy for each medium and consider several factors such as the waste and its constituents, site conditions, environmentally sensitive areas, soil types, possible preferential pathways to ground water or surface water, depth to ground water, and analytical methods required. The SAP must also consider both surface and subsurface soils as well as possible ground water investigation. Area classification, random and directed sampling, and sampling at specific units are discussed below.

2.9.3.1 Area Classification

Areas are classified as unlikely to be contaminated, known to be contaminated, and possibly contaminated (see Section 3.3.3 of the RISC Technical Guide for details on proper area classification). The sampling strategy may vary based on the investigative area classification.

RISC procedures limit a default risk assessment to a maximum source area of 0.5 acre for subsurface soil. This is the largest area for which default values were calculated. Subsurface source areas larger than 0.5 acre cannot be subdivided and require a non-default risk assessment. The simplest non-default risk assessment procedure for larger source areas is to use a smaller dilution attenuation factor in the equation to calculate a non-default closure level (see Chapter 7 of the RISC Technical Guide). However, for surface soil, the Max and Chen tests can be used at areas larger than 0.5 acre by subdividing the area into 0.5 acre areas. In all cases, both surface and subsurface soils must be investigated.

2.9.3.2 Random and Directed Sampling

The two basic options for soil screening to determine if a site will meet closure levels are random and directed sampling. Random sampling is used to determine if an area that may be contaminated is in fact contaminated and if the contamination exceeds default closure values. Directed sampling is used to determine if areas known to be contaminated exceed default closure values. Section 3.4.1 of the RISC Technical Guide discusses these sampling procedures.

The SAP can propose a combination of random and directed sampling and should describe the sampling strategy, which is subject to IDEM

review and approval. The owner or operator may choose not to screen and proceed to the nature and extent determination or remediation (with adequate verification sampling).

All soil analytical results, regardless of whether sampling is random or directed, must be evaluated against the lower of the direct exposure (surface soil) or migration to ground water (subsurface soil) default value. Although the Max and Chen tests use direct exposure (surface soil) closure levels, the entire soil column must meet the lower of the two values. The higher value can be used only if the owner or operator can validly demonstrate that its use will not result in an unacceptable exposure.

Random Sampling

Random sampling can be used in areas classified as "may be contaminated." Sampling locations can be chosen using a random grid method if there is no evidence of releases. Random samples can be collected based on soil stratigraphy similar to the method discussed in Chapter 3.4.3.2 of the RISC Technical Guide. Each soil stratum must be sampled because random sample results confirm the presence or absence of contamination.

Random sampling results should be statistically evaluated to determine if enough samples have been collected by following the procedures in Chapter 1.6 of the RISC Technical Guide. The 95% UCL for each constituent is calculated and compared to the closure level. If the evaluation of random sample results exceeds appropriate closure levels, the nature and extent of contamination must be determined.

Directed Sampling

Generally, directed sampling should be performed at areas known or suspected to be contaminated, such as in areas of cracks, runoff areas of a containment structure, or areas of known spills. The default procedures discussed in Sections 6.3.1 and 6.3.2 of the RISC Technical Guide should be used during directed sampling. The three borings sampled should be in the area of highest contamination (that is, all three results should be reasonably similar). Anomalous or "outlier" results should also be explained.

For volatile constituents, the average of each constituent of the three soil boring samples is calculated. This value is the "potential exposure

concentration" (PEC) for that constituent. For nonvolatile constituents, use only analytical results from strata that have constituents detected. Calculate the average of each constituent within each boring. This is the PEC. PECs (for both volatile and non volatile constituents) are compared to closure levels. (See Section 3.4.4 of the Technical Guide.) If all PECs for a source area are less than closure levels, the source area is not considered to present an exposure risk for human health. Closure can be certified in this case at this point (assuming there are no groundwater issues). If any PEC exceeds the appropriate closure level, the nature and extent of contamination must be determined. (See Chapter 4 of the Technical Guide.)

2.9.3.3 Sampling at Specific Units

Investigative soil sampling is required for storage areas or tanks located on soil or gravel. Sampling locations can be chosen using the random grid sampling strategy if no areas have evidence of releases. If evidence of a release exists, the default direct sampling procedures can be used. The paved or concrete pads of storage areas or tanks must be decontaminated and soils sampled (using default procedures) at areas of cracks, gaps or other damaged areas. Soil sampling at the edge of the pad is also required. Sample results are evaluated using the directed strategy (that is, all strata must be below closure levels) unless there is evidence of a release.

Sampling may not be required for storage areas or tanks in secondary containment. Default procedure sampling is only required if cracks, gaps, or damaged areas of the containment system existed. The secondary containment requires decontamination.

For closure of units other than aboveground tank systems, angled soil borings should be performed, with samples taken at the sides and below the bottom of the tank, and as close to the tank as possible. Additional borings should be located and oriented to allow sampling beneath the tank system. Soil below the bottom of the tank must be sampled in accordance with the procedures in Section 3.4.3.1 and Section 3.4.3.2 of the RISC Technical Guide. However, if the tank is removed, soil verification samples only are required unless contamination is detected above closure levels.

Closure of waste piles and surface impoundments require the complete removal of waste, liners, leachate, and materials contaminated with waste or leachate. Soil sampling should be conducted on a random

grid based on the assumption that the waste was homogeneous and evenly distributed. If the waste was not homogenous, directed default procedures can be used. These units also require Subpart F ground water monitoring, which is discussed in Section 2.10 of this User's Guide.

2.9.4 Sampling to Determine the Nature and Extent of Contamination

If soil screening results indicate that PECs exceed closure levels, a SAP to determine the complete nature and extent of soil contamination is required. The owner or operator should contact IDEM prior to submittal of such a SAP. Not only must the contamination boundaries (vertical and horizontal extent) be determined, a concentration gradient across the contaminated zone (the nature) must also be determined. This gradient will allow a more detailed estimate of risk. (An accurate estimate of risk cannot be made unless it is known how much contamination is present and the location of the contamination.) Chapter 4 of the RISC Technical Guide describes nature and extent determination requirements.

Once the nature and extent of contamination have been determined, a second set of PECs is calculated based on the nature and extent determination results. These PEC values are compared with closure levels. If the PECs are below closure levels, the unit is eligible for closure. Otherwise, options include either a non-default risk assessment or soil remediation. If a risk assessment is not feasible or remediation is not practicable (waste removal and decontamination to an appropriate standard), the unit must be closed in-place.

2.9.5 Closure or Verification Sampling

The RISC Technical Guide requires closure or verification sampling of surface and subsurface soils to demonstrate that contaminant concentrations are below closure levels for each impacted medium. Chapter 6 of the RISC Technical Guide describes the minimum number of samples, sampling locations, and decision criteria for closure sampling.

2.9.6 Industrial Closure Soil Sampling

For industrial closures, it is assumed that the soil or ground water contaminant concentrations exceed residential closure levels. Unless

the unit was closed through screening as provided in Chapter 3 of the RISC Technical Manual, the nature and extent of contamination in soil must be determined for all units using industrial closure levels because it is necessary to define the extent of the soil contamination that might impact ground water above residential values. For facilities with multiple sources, the procedures in RISC Technical Guidance, Section 4.1, page 4-1 may be followed. Ground water must be below default residential values at the boundary of property control.

2.10 RCRA Ground Water Sampling

As stated in Subpart G of 40 CFR 264 and 265, closure is required at all contiguous areas of land on or in which hazardous waste is placed or the largest area in which there is significant likelihood of mixing hazardous waste constituents in the same area. Subpart G of the regulations requires the consideration of ground water when determining clean closure standards (see 53 FR 8705). Therefore, the owner or operator must demonstrate either that there is no evidence of release of hazardous constituents to ground water or that ground water does not pose potential harm to human health or the environment as a result of facility-related contamination. Ground water sampling refers to the sampling needed to determine the extent of decontamination necessary to satisfy closure performance standards.

Ground water protection is a major concern in regulatory strategy for hazardous waste land disposal. Therefore, in addition to ground water sampling to meet closure levels, ground water monitoring is required at surface impoundments, waste piles, and land treatment units or landfills (hereafter referred to as "Subpart F units") that received hazardous wastes after July 26, 1982. Subpart F units must comply with Subpart F requirements for detecting, characterizing, and responding to releases to the uppermost aquifer and any hydraulically interconnected underlying aquifers.

This section clarifies the application of RISC Technical Guide procedures to the RCRA program and presents a discussion of how the procedures either comply with RCRA federal rules, or may necessarily be more stringent than RISC Technical Guide procedures. Within this chapter, ground water monitoring refers to the collection of samples required by Subpart F of 40 CFR 264 and 265.

Ground water is dynamic and can have temporal and spatial contaminant changes. The possibility of missing a plume of ground

water contamination is very likely if the site-specific hydrogeology is unknown. In addition, without significant sampling control, sampling techniques may not ensure the collection of samples representative of ground water within the media. Therefore, valid conclusions based solely on ground water data require strict sample collection control at pre-determined points in time and space based on knowledge of the characteristics of the ground water flow, and capability of obtaining representative samples.

This section discusses the following:

- SAP requirements
- Ground water screening
- Characterization of the nature and extent of contamination
- Ground water closure sampling
- Ground water monitoring

Where applicable, the discussion for each of these topics first addresses Subpart F unit requirements, followed by non-Subpart F unit guidelines.

2.10.1 Sampling and Analysis Plan Requirements

2.10.1.1 Subpart F Unit Requirements

Hazardous constituents under the RCRA program for ground water monitoring include those listed in 40 CFR 264, Appendix IX. The list of hazardous constituents to be analyzed for is based (1) on their presence in ground water (40 CFR 270.14 [c][4][ii]) and (2) their capability for harming human health or the environment (40 CFR 264.93 [b]). A hazardous constituent can be removed from the list of constituents to be analyzed if it can be demonstrated that the constituent is not present in ground water or is not present at concentrations that can pose a substantial present or potential future hazard to human health or the environment. This can be simply demonstrated by determining the total list of constituents in ground water samples. Otherwise, a hazardous constituent can be removed from the list of contaminants of concern if it is demonstrated that the constituent is not capable of posing a substantial present or potential

future hazard to human health or the environment (see 40 CFR 264.93 [b]).

2.10.1.2 Non-Subpart F Unit Requirements

Units not subject to Subpart F monitoring requirements must be sampled and analyzed using consistent procedures as described in Section 3.4.5 and Section 4.4.2 of the RISC Technical Guide. DQOs must be achieved.

Parameters for ground water analysis should include elements or compounds of the hazardous waste, hazardous constituents (as defined in 40 CFR 261, Appendix VIII), or hazardous waste constituents (as defined in 40 CFR 260.10). Parameters can be proposed by the owner or operator or IDEM. For Corrective Action purposes, the initial parameter list is comprised of any hazardous waste or hazardous constituent used at the facility, as well as any breakdown product or by-product of a hazardous waste or hazardous constituent used at the facility. With sufficient justification, parameters can be eliminated from the list during SAP preparation. Parameters can also be eliminated depending on sampling results. Parameters should be selected based on knowledge of wastes managed at each unit and may include other potential elements or compounds related to facility operations (such as breakdown products). This strategy is similar to U.S. EPA considerations for waste de-listing.

2.10.2 Ground Water Screening

2.10.2.1 Subpart F Unit Requirements

Screening under the RCRA ground water monitoring program is based on determining if a release has occurred from a unit to the uppermost aquifer at the compliance point. Subpart F units that meet the requirements of the indicator monitoring program of 40 CFR 265 and of the detection monitoring program of 40 CFR 264 satisfy the objectives of the screening process discussed in Chapter 3 of the RISC Technical Guide. The nature and extent of ground water contamination does not have to be characterized to satisfy the requirements discussed in Chapter 4 of the RISC Technical Guide if both of the situations below apply.

1. An adequate monitoring program at the unit has not yielded results that indicate a statistically significant indication of release during the unit's operation (including closure period).

2. Soil screening results indicate that hazardous constituents have not migrated from the unit to the uppermost aquifer.

If ground water monitoring results indicate detection of the presence of hazardous constituents from a Subpart F unit, an appropriate ground water monitoring program (that is, ground water quality assessment under 40 CFR 265 or compliance monitoring under 40 CFR 264) must be implemented at the compliance point. Detection is defined by statistically significant evidence that contamination exists, determined by comparing data collected at the compliance point(s) to the background water quality data.

Subpart F requirements do not apply after closure if all waste, waste residues, contaminated containment system components, and contaminated subsoil including ground water are removed or decontaminated to land use appropriate levels at closure. Chapter 6 of the RISC Technical Guide presents a methodology for demonstrating that a unit meets the closure performance standards and presents no potential harm to human health or the environment.

The groundwater sampling requirements for closure by removal and in-place closure are discussed further in the following sections.

2.10.2.2 Non-Subpart F Unit Requirements

Ground water screening at units not subject to Subpart F can consist of the method for screening presented in Section 3.4.5 of the RISC Technical Guide. In accordance with the strategy for ground water monitoring, as evidence increases that a release has occurred, additional sampling and analysis of ground water is needed to demonstrate that closure performance standards are not exceeded. Examples of situations that may require additional sampling of ground water include the following:

1. Detection of a hazardous constituent during ground water screening
2. Detection of a VOC hazardous constituent at concentrations exceeding the residential level in a preferential pathway to ground water
3. Detection of a VOC hazardous constituent at a concentration exceeding the residential level within the first sedimentary layer of similar texture and material above the saturated zone in soil screening
4. Subsurface soil sampling results indicate the presence of a non-VOC hazardous constituent at a concentration exceeding the residential level and the constituent is detected within the first sedimentary layer of similar texture and material above the saturated zone
5. Subsurface soil sampling results indicate the presence of a non-VOC hazardous constituent at a concentration exceeding the residential level and the constituent is detected in saturated soil.

If ground water samples are collected, it may be beneficial to also collect saturated soil samples in order to describe the saturated soil as was done for other soil samples.

If no constituent levels exceed closure levels, no other aspects of the nature and extent determination described in Chapter 4 of the RISC Technical Guide are necessary. If the closure performance standard for ground water is exceeded, characterization of the nature and extent of contamination (see Section 2.10.3 below) is necessary to determine the extent of remediation necessary (40 CFR 264.112 [b][4]).

2.10.3 Characterization of the Nature and Extent of Contamination

2.10.3.1 Subpart F Unit Requirements

To meet the requirements of a ground water quality assessment under 40 CFR, Part 265, or compliance monitoring under 40 CFR, Parts 264 and 270.14(c)(3) and (4), ground water monitoring must continue at least until the compliance period is completed (see 40 CFR 264.92). The compliance period is the number of years equal to the active life of the waste management area, including any waste management activities conducted prior to permitting and closure.

An adequate ground water quality assessment plan or compliance monitoring program should satisfy the objectives of the nature and extent determination outside the compliance point as discussed in Chapter 4 of the RISC Technical Guide. However, to satisfy closure performance standards, it may be necessary to determine the nature and extent of contamination for the plume within the compliance point.

If the assessment of the quality of the ground water shows that the unit has released hazardous constituents to the uppermost aquifer, post-closure care is required unless there is an adequate closure by removal.

If the owner or operator can demonstrate that a source other than a regulated unit caused the release to the ground water or if the detection was an artifact caused by an error in sampling, analysis, statistical evaluation or natural variation in the ground water, they are released from the requirements of ground water quality assessment under 40 CFR 265 or compliance monitoring under 40 CFR 264.

Characterizing the contamination also requires knowledge of the hydrogeology of the area. The uppermost aquifer unit and any hydraulically interconnected underlying aquifers (that is, all likely subsurface flow paths for hazardous constituents that could be released from the unit) should be identified. The hydrogeologic properties (for example, hydraulic gradient, ground water flow, rate, and direction), beneath the facility should be known and the supporting data used to identify this information (such as hydrogeologic investigation reports for the facility area) should be provided in the SAP. This information should be included in a report written by a qualified hydrogeologist on the hydrogeologic characteristics of the facility property supported by drilling logs for on-site borings and wells and available professional literature. A description of the regional geologic and hydrogeologic setting should also be included in the report. Guidance for establishing an adequate hydrogeology study is presented in U.S. EPA's 1986 "RCRA Ground-Water Monitoring Technical Enforcement Guidance

Document" (OSWER Directive No. 9950.1) or 1992 "RCRA Ground-Water Monitoring: Draft Technical Guidance Document" (EPA/530-R-93-001).

2.10.3.2 Non-Subpart F Unit Requirements

For units not subject to Subpart F requirements, the guidance in Chapter 4 of the RISC Technical Guide can be used to determine the extent of remediation necessary to meet the closure performance standards. One sampling event may not be adequate to define the characteristics of the nature and extent of contamination. Many times the investigation should proceed in phases, until the three-dimensional limit of the contaminant plume is defined. The final phase consists of conducting a controlled sampling program to determine the concentrations and movement of the contaminants within the plume. If the nature and extent procedure has shown that the unit released a listed hazardous waste into the ground water, the boundary between waste and contaminated media must be determined. ***Groundwater containing one or more hazardous constituents may not constitute a "waste", but may be considered a contaminated medium.*** The owner or operator may submit a justification of the distinction between hazardous waste and contaminated media. For closure by removal or decontamination, the hazardous waste must be removed and affected media must meet the land-use specific closure performance standard.

2.10.4 Ground Water Closure Sampling

2.10.4.1 Subpart F Unit Requirements

This section clarifies the procedures necessary to ensure that closure activities are in compliance with RCRA Subpart F requirements and satisfy closure performance standards. If hazardous constituents are not detected in the uppermost aquifer at the compliance point for a Subpart F unit, a detection monitoring program in accordance with 40 CFR 264.98 must be established to demonstrate that applicable closure standards have been met. If hazardous constituents are detected from a Subpart F unit at the compliance point during ground water monitoring, a compliance monitoring program must be implemented. Under the RCRA ground water monitoring program, the point of initial discovery is the compliance point. The ground water protection standard for Subpart F units must be met at the compliance point until completion of the compliance period as described in 40 CFR 264.95.

Upon demonstration of closure by removal or decontamination, a closure certification must be submitted to verify that the approved closure plan has been followed and to document that the Subpart F unit is compliant with the requirements of Subpart F. Subpart F requirements no longer apply after IDEM accepts the closure certification.

Within the compliance point, it must be demonstrated that there has not been a release to ground water beneath the waste management boundary. When a release has occurred or there is a potential release that exceeds the residential ground water level, additional ground water sampling is required as described below for units not subject to Subpart F requirements. Any deviations from the SAP resulting from problems encountered in obtaining representative ground water samples or from knowledge of the area should be adequately justified and discussed with IDEM.

2.10.4.2 Non-Subpart F Unit Requirements

For hazardous waste management units, SWMUs, and AOCs not subject to 40 CFR 264.91 through 264.100, it may have to be demonstrated that ground water beneath the units does not have a plume containing hazardous wastes or hazardous constituents, or that the plume will not present potential harm to human health or the environment. Obviously, if all hazardous waste is contained in a material that is removed, the closure performance standard has been achieved. However, if contaminated media are left in place exceeding land use specific closure levels**,** the potential for ground water degradation from soil leaching, or present ground water migration must also be determined.

When a hazardous waste or hazardous constituent from the unit is detected in ground water, the closure performance standard can be achieved by demonstrating maximum concentrations within the plume are below land use specific levels, and below residential levels at the point of property control. In addition, the owner or operator must demonstrate that the closure has controlled or minimized to the extent necessary to protect human health and the environment, post-closure escape of hazardous constituents or hazardous waste decomposition products to the groundwater.

Where there are multiple potential sources of particular hazardous wastes or hazardous constituents, or for large sites, the overall control

of the groundwater plume may be consolidated into one monitoring program. The Office of Land Quality has a non-rule policy document that addressed the issue of multiple sources (WASTE-0015-NPD).

Maximum concentrations detected when determining the nature and extent of the plume in ground water may determine the length of time needed to demonstrate closure. In order to demonstrate that concentrations within the plume do not exceed land-use specific closure levels throughout the plume and residential levels at the point of property control, a sampling program must be established to allow data evaluation once remediation has taken place. This sampling program is described in Chapter 6 of the RISC Technical Guide. The owner or operator may demonstrate that the closure activities have adequately controlled or minimized the plume by utilizing the Mann-Kendall trend test. Additional sampling may be necessary, if there is a statistically significant increase during the monitoring program.

If the statistical evaluation indicates that the land-use specific closure performance standard is achieved, the unit is eligible for closure by removal. If statistical evaluation indicates closure performance standards are exceeded, post-closure care (that is, post-closure permitting or corrective action) is required.

2.10.5 Contaminated Ground Water In-Place

When land-use specific levels are exceeded, additional sampling may be needed to demonstrate that the plume is controlled or minimized to the extent necessary to protect human health or the environment from hazardous constituents, or hazardous waste, or their decomposition products to the groundwater that may escape after closure. To satisfy the closure standard, it must be shown that the residential levels at the point of property control will not be exceeded and the land-use specific levels will not be exceeded beyond the perimeter of compliance. This can be demonstrated by plume stability as described in Appendix 3 of the RISC Technical Guide.